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A WATER SAMPLER FOR OBTAINING RIVER WATER SAMPLES UNDER SEVERE WINTER CONDITIONS

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Report On:

A WATER SAMPLER FOR OBTAINING RIVER WATER SAMPLES UNDER SEVERE WINTER CONDITIONS

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16. Abstracts

A method for obtaining samples of stream water in areas of subzero temperatures and heavy ice cover is described. The method uses an intake consisting of a submersible, semipositive displacement pump; a 3/4-inch discharge line; a 2-1/2-inch protective sleeve; heat tapes and insulation; and various other appurtenances.

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A. INTRODUCTION

Baudette, located on the Rainy River in northern Minnesota, has been the site of a water quality surveillance station since September 1961. Due to its northern location, sub-zero temperatures and heavy ice cover are not uncommon. These severe winter conditions pose a special problem in trying to obtain water samples of the Rainy River on a year round basis.

The purpose of this paper is to describe the method used to resolve the sampling problem at Baudette, Minnesota thereby presenting a suitable solution for river sampling in areas where similiar severe winter conditions exist.

B. STATION DESCRIPTION

The Rainy River forms the boundary between north central Minnesota and Ontario, Canada. The water quality surveillance station at Baudette is approximately 19 miles upstream from the point where the Rainy River empties into Lake-of-the-Woods. There is considerable recreational fishing and boating on the Rainy River and the Lake-of-the-Woods in the vicinity of the Baudette station.

The major source of wastes being discharged to the river is from pulp and paper mills located approximately 75 miles upstream from Baudette in the International Falls, Minnesota - Fort Frances, Ontario area. An outline of pertinent flow information is given below:

1. Period of record: 1928 to present
2. Average discharge in record period: 11,800 cfs
3. Maximum discharge in record period: 71,600 cfs
4. Minimum discharge in record period: 928 cfs

In the past, the intake at Baudette consisted of a flexible intake line which was attached to the center pier of a Canadian railroad bridge. The line was run along the bottom of the river and then underground to the Baudette Light and Power Company Building. Samples were taken using a centrifugal pump located in the Power Company Building. Significant problems were encountered with this system. During winter months the line tended to freeze and frequently throughout the year the centrifugal pump clogged with wood fibers.

From the fall of 1967 to the winter of 1969, the flexible intake line was completely clogged. As a consequence, no samples were taken in the winter months and samples had to be collected from a dock during the spring, summer, and fall months. No organic samples by the carbon adsorption method were taken since the fall of 1967.

C. THE BAUDETTE INTAKE

An intake has been designed and is presently in operation at Baudette, Minnesota that has eliminated the sampling difficulties encountered with the old intake. The intake consists of a submersible, semi-positive displacement pump, a 3/4 inch discharge line, a 2½ inch protective sleeve, heat tapes and insulation, and various other appurtenances. The intake was fastened to the downstream side of the center pier of the Baudette International Bridge.

The various components of the intake are described below. (Schematic diagrams are shown in Figures 1, 2, and 3.)

1. Pump

The pump is a ½ horsepower, semi-positive displacement, submersible pump, manufactured by Peerless Pump, Hydrodynamics Division, FMC Corporation under the trademark name Dynaflo. This type of pump will not clog as easily as a centrifugal pump and is believed to have virtually no effect on water quality parameters such as dissolved oxygen. The pump requires a 220 volt power supply which may be difficult and costly to provide. A smaller pump of this type (1/3 horsepower) is available which can operate off a 110 volt power supply and would generally be adequate to provide the supply of water needed to sample at a surveillance station. It should be noted that the check value was removed from the pump before installation, thereby allowing the discharge line to drain after each sample is taken.

2. Discharge Line

The pump discharge port is designed for a 1 inch discharge line. A 3/4 inch discharge line was used at Baudette to reduce the weight of the intake. This also allowed for a reduction in the diameter of pipe needed for the protective sleeve. It is believed that a ½ inch discharge line would be adequate on any future installations.

3. Protective Sleeve

That portion of the discharge line that is or may be affected by the ice cover on the river is protected with a galvanized pipe 2½ inches in diameter. At the Baudette installation, this section is approximately 20 feet long. A 2½ by 3/4 inch reducer was used to make the waterproof connection at the

bottom of the protective sleeve. To allow for the extension of the discharge line, a 3/4 inch nipple was welded on the 3/4 inch pipe at the waterproof connection. (See Figure 3) The top of the protective sleeve was sealed against the rain with roofing tar. A 20 foot heat tape (described below) and fiberglass insulation were installed in the opening between the 3/4 inch discharge line and the 2½ inch protective sleeve. This 20 foot section was made detachable from the rest of the intake by putting couplings at both ends.

4. Heat Tapes

The heat tape used in the 20 foot protective sleeve section was an Easy-Heat Flexible Copper Tube Heater. It was purchased from Border States Electric Supply Company, Grand Forks, North Dakota. The tape (heater) is 20 feet long and was fastened to the 3/4 inch discharge line. This tape is sturdy and provides ample heat to prevent freezing of the discharge line.

The remainder of the intake discharge line was wrapped with a conventional plastic coated heat tape which was insulated with fiberglass and a thin plastic wrap-on coating.

5. Other Components

The wiring leading to the submersible pump is completely enclosed in electrical conduit.

A faucet is provided at the outlet end of the discharge line to allow for control of the flow during sampling.

The heat tape control, the motor control, and the outlet faucet are mounted on a plywood board on the deck of the bridge.

D. OPERATION

The intake was installed and placed in operation in late January 1969. Initially a conventional plastic coated heat tape was used in the 20 foot protective sleeve section. This tape burned itself out after a week's operation and had to be replaced with the copper tube heater. As proof of its ruggedness in extreme temperature and ice conditions, the intake has supplied water samples at temperatures of -20° F. with 41 inches of ice cover.

E. COST

The cost of the components of the intake structure are outlined below:

Article	Cost
Pump	$165.00
Copper Heater (20')	18.95
3/4" Galvanized Pipe	15.00
2½" Galvanized Pipe	29.40
Insulation	20.00
Extension Cord	8.40
Angle Iron for Brackets	9.00
Heat Tape	3.00
Miscellaneous (Elbows, Couplings, Gate Valve, Reducer, Etc.)	14.10
Total Cost	$282.85

The cost of the electrical wiring was not itemized but was given as a lump sum bid. The accepted bid for wiring the pump and heat tapes and providing a power source was $550. This cost would have been

decreased if just a 110 volt power supply had been provided. Both 110 and 220 volt supplies were provided at the Baudette intake.

The labor cost for installation of the intake totaled $406. Therefore the total initial cost of the intake installation was:

Parts	$ 282.85
Electric Wiring	550.00
Labor	406.00
Total	$1238.85

It is believed that on future installations this initial cost can be greatly reduced. The following reasons for a cost reduction are given.

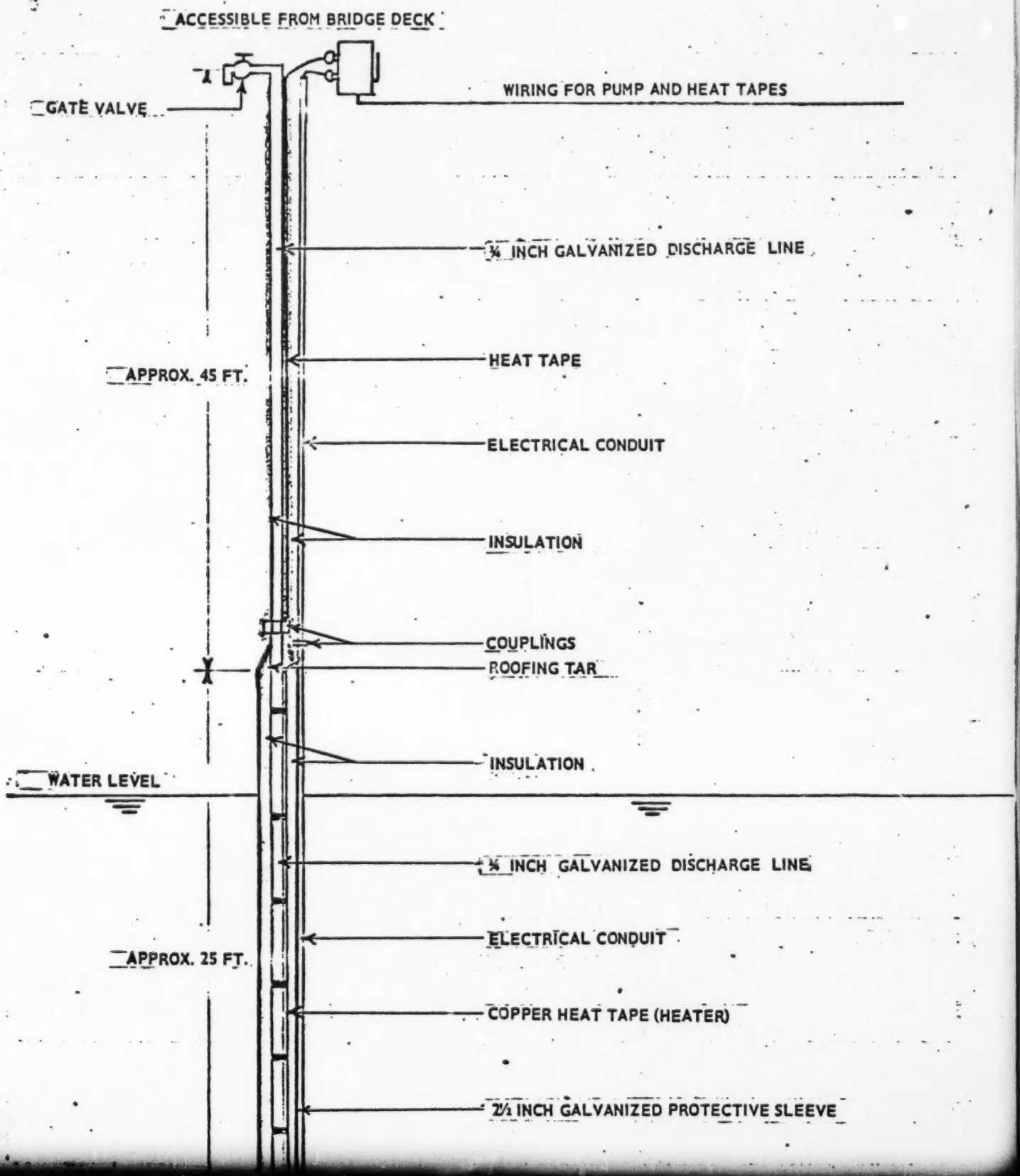
1. In most cases the 1/3 horsepower pump may be used rather than a ½ horsepower. Since the 1/3 horsepower pump may be operated on 110 volts, this would allow both the pump and heat tapes to be operated off a 110 volt power supply.
2. Smaller diameter pipes may be used which would make the unit easier to handle and thus would reduce labor costs.
3. Generally for most installations the intake will be placed on a smaller stream and thus a smaller bridge. The deck of the Baudette Bridge is approximately 50 feet above the water. Mounting an intake on a bridge of this type presents numerous construction difficulties that would not be encountered on a smaller bridge.

F. SUMMARY AND CONCLUSION

The water intake at Baudette, Minnesota provides a suitable method to obtain water samples throughout the year, even under severe winter conditions. Its only apparent limitations are that the intake

is restricted to an area where a superstructure over the river exists and to an area where a power source is available.

FIGURE 1 LINE DIAGRAM — BAUDETTE INTAKE



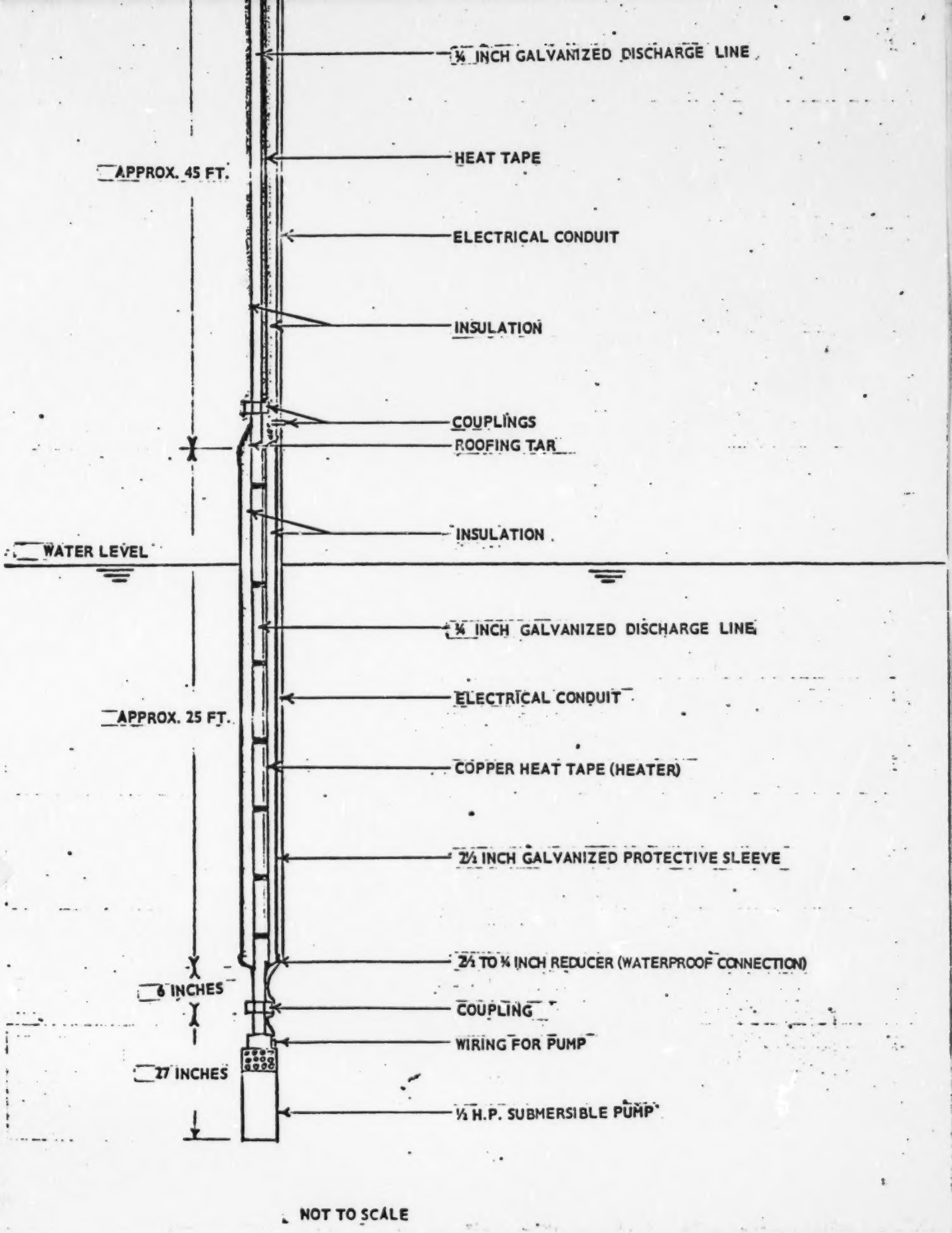

¼ INCH GALVANIZED DISCHARGE LINE
HEAT TAPE
APPROX. 45 FT.
ELECTRICAL CONDUIT
INSULATION
COUPLINGS
ROOFING TAR
INSULATION
WATER LEVEL
¼ INCH GALVANIZED DISCHARGE LINE
ELECTRICAL CONDUIT
APPROX. 25 FT.
COPPER HEAT TAPE (HEATER)
2½ INCH GALVANIZED PROTECTIVE SLEEVE
2½ TO ¼ INCH REDUCER (WATERPROOF CONNECTION)
6 INCHES
COUPLING
WIRING FOR PUMP
27 INCHES
½ H.P. SUBMERSIBLE PUMP
NOT TO SCALE

FIGURE 2 – CROSS-SECTION OF PROTECTIVE SLEEVE

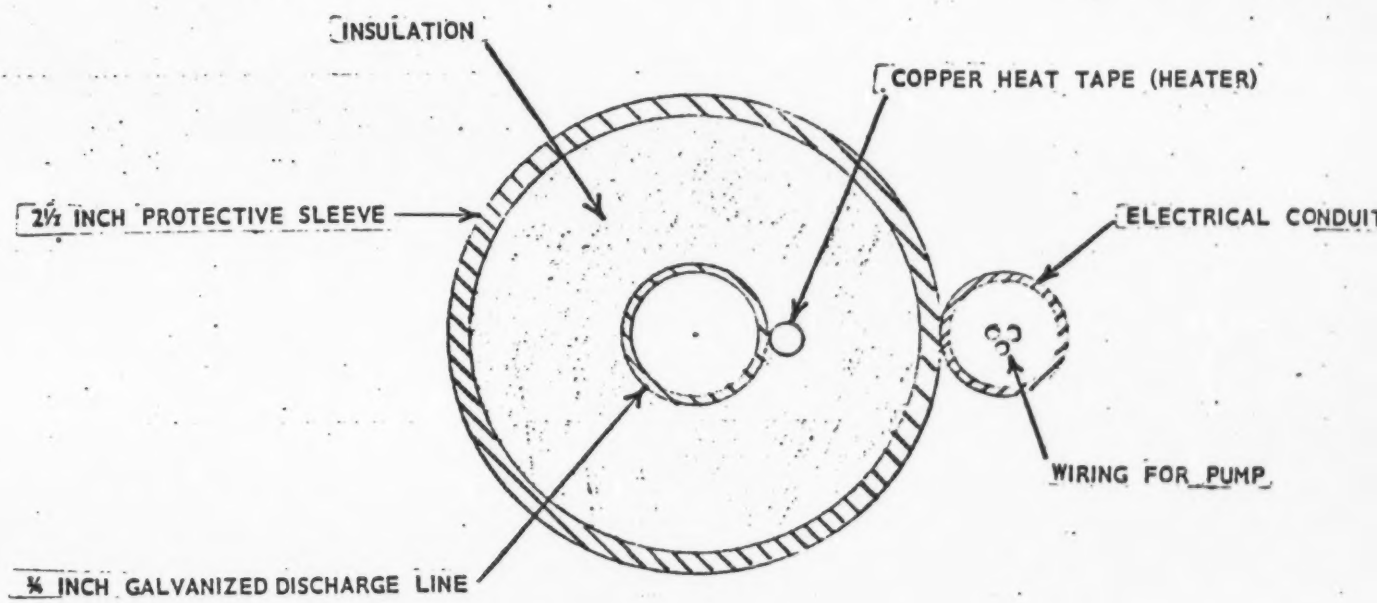
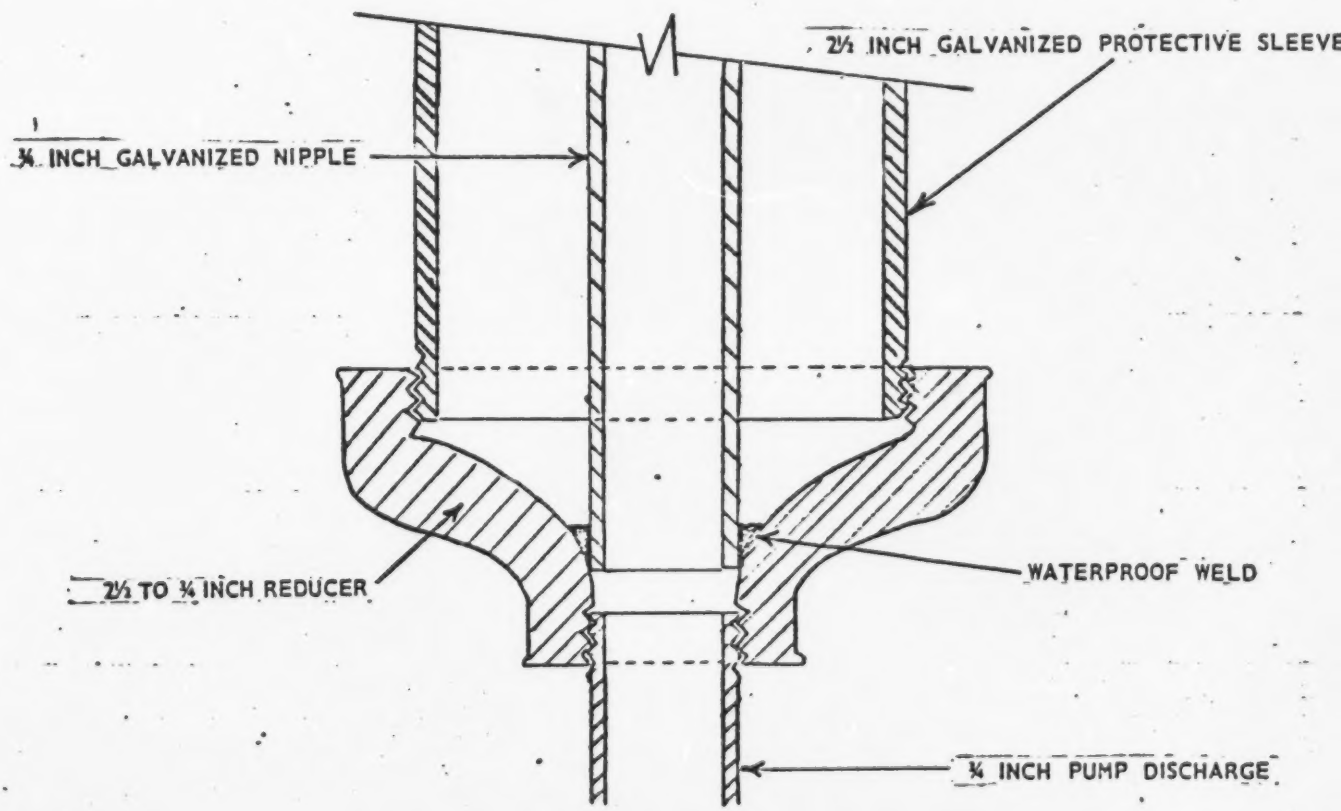


FIGURE 3 – CROSS-SECTION OF WATERPROOF CONNECTION


2½ INCH GALVANIZED PROTECTIVE SLEEVE
¾ INCH GALVANIZED NIPPLE
2½ TO ¾ INCH REDUCER
WATERPROOF WELD
¾ INCH PUMP DISCHARGE